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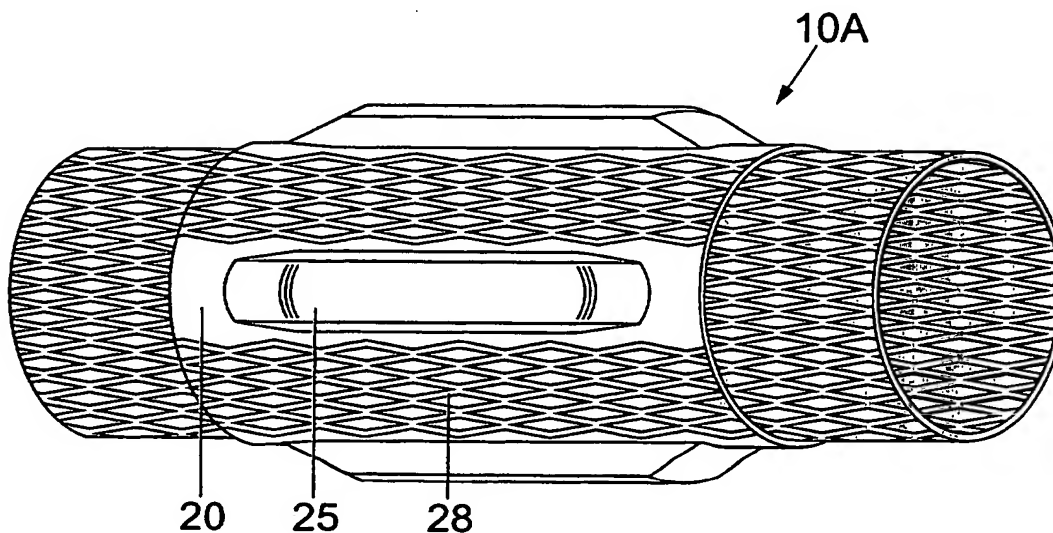
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(54) Title: SLOTTED EXPANDABLE CENTRALISER



(57) Abstract: This invention relates to a slotted expandable centraliser. In preferred embodiments, the centraliser is adapted to be used in conjunction with slotted casing, and can expand with the casing when an expander cone is propelled through the casing.

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— *before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments*

*For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.*

## SLOTTED EXPANDABLE CENTRALISER

1

2

3 This Application relates to a centraliser for an oil  
4 well tubular.

5

6 Expandable centralisers are known, such as the bow-  
7 spring centraliser, which employs resilient bow-  
8 springs that are biased into an expanded  
9 configuration, and forced into a narrower bore so  
10 that the springs deform between the body of the  
11 centraliser and the borehole to space the  
12 centraliser body apart from the borehole.

13

14 According to the present invention there is provided  
15 a slotted expandable centraliser.

16

17 Typically the centraliser has a body with a bore to  
18 accept a tubular, and is radially expandable to an  
19 expanded configuration on application of a force in  
20 a radial direction.

21

1 Preferably, the centraliser has blades that can  
2 project radially outward from the body of the  
3 centraliser in a non-expanded configuration.

4

5 Preferably, the blades and the centraliser are made  
6 from a metal such as steel, and can be of the same  
7 thickness.

8

9 Optionally, the blades can project outwardly from  
10 the body of the centraliser in the expanded  
11 configuration. Alternatively, the blades can change  
12 configuration during expansion of the centraliser so  
13 that the expanded configuration can have a more  
14 uniform radius.

15

16 Preferably, the centraliser has at least two slots.

17

18 Preferably, the slots are longitudinal in the non-  
19 expanded configuration, and open to generally  
20 diamond-shaped apertures in the expanded  
21 configuration. Typically, slots are arranged in  
22 longitudinally aligned rows with slots in adjacent  
23 rows being axially offset with respect to one  
24 another, so that the ends of circumferentially  
25 adjacent slots overlap. The rows and the slots  
26 themselves need not be axially aligned; this is  
27 merely a preferred option.

28

29 Alternatively, the slots are C-shaped in the non-  
30 expanded configuration. Other shapes of slots are  
31 possible, such as Z-shapes.

32

1 Preferably, the slots are of uniform dimension, but  
2 this is not necessary.

3

4 Optionally, slots are uniformly distributed over the  
5 body and the blades. Alternatively, the centraliser  
6 has slotted portions circumferentially adjacent to  
7 non-slotted portions.

8

9 Optionally, the non-slotted portions include at  
10 least one blade.

11

12 Optionally, all of the blades are located in non-  
13 slotted portions.

14

15 Typically, the centraliser is made from a material  
16 which is capable of plastic and/or elastic  
17 deformation.

18

19 Typically the centraliser is adapted to receive an  
20 expandable tubular within its bore and is adapted to  
21 deform radially with the expandable tubular during  
22 expansion.

23

24 According to another aspect of the present  
25 invention, there is provided a centraliser assembly  
26 comprising a slotted expandable centraliser which  
27 has a body with a bore to accept a tubular, and is  
28 radially expandable on application of a force in a  
29 radial direction to an expanded configuration; and  
30 an expandable tubular, located in the bore of the  
31 centraliser.

32

1 The tubular can comprise production tubing, casing,  
2 liner, drill pipe, screen, perforation guns or any  
3 other kind of downhole tubular.

4

5 Preferably, the force to expand the centraliser is  
6 provided by an expander device such as an expansion  
7 cone being pushed or pulled through the tubular.

8

9 The slots can have a typical length of between 1 and  
10 5cm, but this is only optional, and other lengths of  
11 slot can be used.

12

13 An embodiment of the invention will now be described  
14 by way of example only and with reference to the  
15 accompanying drawings, in which:-

16

17 Fig 1A shows a perspective view of a  
18 centraliser in an initial, non-expanded  
19 configuration;

20 Fig 1B shows the centraliser of Fig 1A in an  
21 expanded configuration;

22 Fig 2A shows an alternative embodiment of a  
23 centraliser in a non-expanded configuration;  
24 and

25 Fig 2B shows the centraliser of Fig 2A in an  
26 expanded configuration.

27

28 Referring now to the drawings, Fig 1A shows a steel  
29 centraliser 10 in a non-expanded configuration,  
30 attached to a slotted expandable steel tubular 12.  
31 The slotted expandable steel tubular 12 is well  
32 known in the art. Both the centraliser 10 and the

1 tubular 12 have many slots 18, distributed  
2 approximately uniformly over the surface.

3

4 The centraliser 10 comprises a body 14 and blades 16  
5 which project radially outwards from the body 14 in  
6 the non-expanded configuration shown in Fig 1A. In  
7 this embodiment the blades 16 are hollow projections  
8 formed by pressing the blade shape from the body 14,  
9 and are of the same thickness and material as the  
10 body of the centraliser 10. The blades 16 each  
11 comprise an outer face 16A, side walls 16B and end  
12 walls 16C.

13

14 The slots 18 are typically between 1-5cm in length  
15 and are arranged in parallel rows that are aligned  
16 with the axis of the tubular 12 and the centraliser  
17 10. Slots in circumferentially adjacent rows are  
18 axially offset with respect to one another, so that  
19 the ends of the circumferentially adjacent slots  
20 overlap, leaving a web of metal between the ends of  
21 axially adjacent slots, and their circumferentially  
22 adjacent neighbours. Each slot 18 has a much  
23 shorter length than the axial length of the  
24 centraliser 10. The slots 18 cover both the body 14  
25 and the blades 16.

26

27 All of the slots 18 may be of uniform size and  
28 shape, or alternatively, the slots on the blades 16  
29 could be differently shaped to the slots on the body  
30 14.

31

1 In use, an unexpanded centraliser 10 is fitted onto  
2 a string of expandable tubulars 12, with the tubular  
3 12 received within the bore of the centraliser as  
4 shown in Fig 1A. The string is lowered into a  
5 borehole to the depth where expansion of the tubular  
6 12 is desired. An expander device (not shown) is  
7 then pulled or pushed through the tubular 12. A  
8 possible expander device is an expander cone, which  
9 is typically pulled/pushed by a hydraulic ram or by  
10 fluid pressure. The expander device expands the  
11 tubular 12 as it passes through it, and as the  
12 tubular expands this expands the centraliser 10  
13 located on the outer surface of the tubular 12.

14

15 The largest end of the cone has a greater cross-  
16 sectional area than that of the non-expanded  
17 centraliser, so as the cone passes the centraliser  
18 10, the centraliser 10 experiences a radial  
19 expansion force from the expander cone (transmitted  
20 via the expandable tubular 12). The two sides of  
21 each slot on the centraliser 10 are pushed apart  
22 from each other, which widens the slot to the extent  
23 permitted by the web of metal between adjacent  
24 slots. Thus, the slots change shape; from being  
25 long and thin, they become shorter, fatter diamond-  
26 shaped apertures. The centraliser radially expands  
27 to the size of the widest part of the expander cone.  
28 The shape of the final aperture in the expanded  
29 centraliser 10 is determined by the size, shape and  
30 strength of the web between the slots.

31



1     The blades 16 do not need to expand as much as the  
2     body 14 of the centraliser 10 in order to  
3     accommodate the expander cone, as they have already  
4     been pressed out of the body of the centraliser 10.  
5     Thus, the slots of the outer faces 16A may adopt a  
6     different shape ( e.g. narrower) on expansion as  
7     compared with the slots on the body of the  
8     centraliser 10. Likewise, parts of the side walls  
9     16B and end walls 16C need to expand more than other  
10    parts, so there can optionally be a non-uniform  
11    pattern of apertures on the expanded centraliser,  
12    which can be used to influence the shape and  
13    strength characteristics of the expanded centraliser  
14    10. After the cone has passed the centraliser 10,  
15    the whole centraliser 10 adopts approximately the  
16    same inner diameter as the outer diameter of the  
17    tubular 12.

18  
19    Fig 1B shows the centraliser 10 of Fig 1A in an  
20    expanded configuration. The outer faces 16A of the  
21    arms 16 have expanded less than the body of the  
22    centraliser 10, so that the expanded centraliser 10  
23    has a generally uniform radius.

24  
25    This embodiment is useful for inserting expandable  
26    tubulars such as screens into a borehole, where the  
27    blades 16 of the centraliser 10 are required to ease  
28    entry of the string into the hole but are not  
29    required after expansion of the screen against the  
30    borehole wall. With slotted blades as in this  
31    embodiment, the centraliser can ease the passage of  
32    the string into the hole, reducing friction between

1 the screen and the hole, and spacing the screen from  
2 the wall to enhance insertion, and after expansion  
3 of the string can virtually disappear against the  
4 borehole wall.

5  
6 In this embodiment the pattern of the slots on the  
7 blades and the body are substantially the same and  
8 this can give rise to a non-uniform pattern of  
9 apertures on the expanded centraliser. In other  
10 embodiments, the pattern or shape of the slots on  
11 the blades 16 can differ from the pattern or shape  
12 of the slots on the body of the centraliser 10, so  
13 as to adopt a more uniform pattern of apertures  
14 after expansion of the centraliser 10.

15  
16 Fig 2A shows an alternative embodiment of a  
17 centraliser 10A. The centraliser 10A has a body 24  
18 and longitudinal strips 20, which are not slotted.  
19 Blades 25 are positioned on the longitudinal non-  
20 slotted strips 20. The rest of the centraliser 10A  
21 is slotted, as in the embodiment of Figs 1A and 1B.

22  
23 Slots 28 are aligned axially in rows, as in the  
24 embodiment of Figs 1A and 1B. Slots 28 in adjacent  
25 rows are axially offset with respect to one another.  
26 Each slot 28 has a much shorter length than the  
27 axial length of the centraliser 10A.

28  
29 In use, the centraliser 10A is attached to a portion  
30 of slotted pipe and expanded in the same way as the  
31 centraliser 10 of Figs 1A and 1B, i.e. by means of  
32 an expander cone. The slotted parts of the

1 centraliser 10A expand in the way described above:  
2 the two sides of each slot are pushed apart from  
3 each other, which widens the slot. The long thin  
4 slots become shorter, fatter diamond-shaped  
5 apertures.

6  
7 The non-slotted strips 20 do not substantially  
8 expand (apart from possibly some plastic/elastic  
9 deformation). Thus, the non-slotted strips 20 do  
10 not change their shape substantially, and the blades  
11 25 remain protruding from the expanded body 24.  
12 They may become further circumferentially spaced  
13 apart from each other, due to the expansion of the  
14 slotted parts of the body 24 between the blades 25.  
15 Fig 2B shows the centraliser 10A of Fig 2A in an  
16 expanded configuration.

17

18 This embodiment is suitable for expandable casing  
19 strings that still require a centraliser function  
20 after expansion, for example to provide an annulus  
21 for cement, or to wash out debris or other material  
22 from the well after insertion of the casing.

23

24 It should be noted that it is possible to provide  
25 some embodiments with intermediate properties, for  
26 example a slotted body and blades with comparatively  
27 fewer slots, so that the blades can expand less than  
28 the body, and a small blade structure is left after  
29 expansion.

30

31 Modifications and improvements can be incorporated  
32 without departing from the scope of the invention

1     Claims

2

3     1.    A slotted expandable centraliser.

4

5     2.    A centraliser as claimed in claim 1, having a  
6     body with a bore to accept a tubular, and being  
7     adapted to expand radially from a non-expanded  
8     configuration to an expanded configuration.

9

10    3.    A centraliser as claimed in claim 2, wherein  
11    the slots are longitudinal in the non-expanded  
12    configuration and diamond-shaped in the expanded  
13    configuration.

14

15    4.    A centraliser as claimed in claim 2 or claim 3,  
16    being adapted to receive an expandable tubular and  
17    adapted to deform radially with the expandable  
18    tubular upon expansion of the tubular.

19

20    5.    A centraliser as claimed in any of claims 2 to  
21    4, wherein the centraliser has at least one blade  
22    that projects radially outward of the body in the  
23    non-expanded configuration.

24

25    6.    A centraliser as claimed in claim 5, wherein  
26    the at least one blade projects radially outward of  
27    the body in the expanded configuration.

28

29    7.    A centraliser as claimed in claim 5 or claim 6,  
30    wherein the at least one blade is adapted to change  
31    configuration during expansion of the centraliser.

32

1 8. A centraliser as claimed in claim 5 or claim 6,  
2 wherein the at least one blade is adapted to retain  
3 its configuration during expansion of the  
4 centraliser.

5

6 9. A centraliser as claimed in any of claims 5 to  
7 8, wherein the at least one blade has the same  
8 thickness as the body.

9

10 10. A centraliser as claimed in any preceding  
11 claim, having slotted portions circumferentially  
12 adjacent to non-slotted portions.

13

14 11. A centraliser as claimed in claim 10 when  
15 dependent on any of claims 5 to 9, wherein the at  
16 least one blade is located in a non-slotted portion.

17

18 12. A centraliser as claimed in any of claims 1 to  
19 9, wherein the slots are uniformly distributed over  
20 the centraliser.

21

22 13. A centraliser as claimed in any preceding  
23 claim, wherein the slots are arranged in  
24 longitudinally aligned rows with slots in adjacent  
25 rows being axially offset with respect to one  
26 another so that the ends of circumferentially  
27 adjacent slots overlap.

28

29 14. A centraliser as claimed in any preceding  
30 claim, wherein the slots are of uniform dimension.

31

1 15. A centraliser as claimed in any preceding  
2 claim, being adapted to deform plastically.

3

4 16. A centraliser as claimed in any preceding  
5 claim, being adapted to deform elastically.

6

7 17. A centraliser as claimed in any preceding  
8 claim, being a casing centraliser.

9

10 18. A centraliser assembly comprising a slotted  
11 expandable centraliser which has a body with a bore  
12 to accept a tubular, and is radially expandable from  
13 a non-expanded configuration to an expanded  
14 configuration; and an expandable tubular, located in  
15 the bore of the centraliser.

16

17 19. An assembly as claimed in claim 18, wherein the  
18 centraliser is a casing centraliser.

19

20 20. An assembly as claimed in claim 18 or 19,  
21 wherein the tubular comprises casing, liner or a  
22 screen.

1 / 2

Fig. 1B

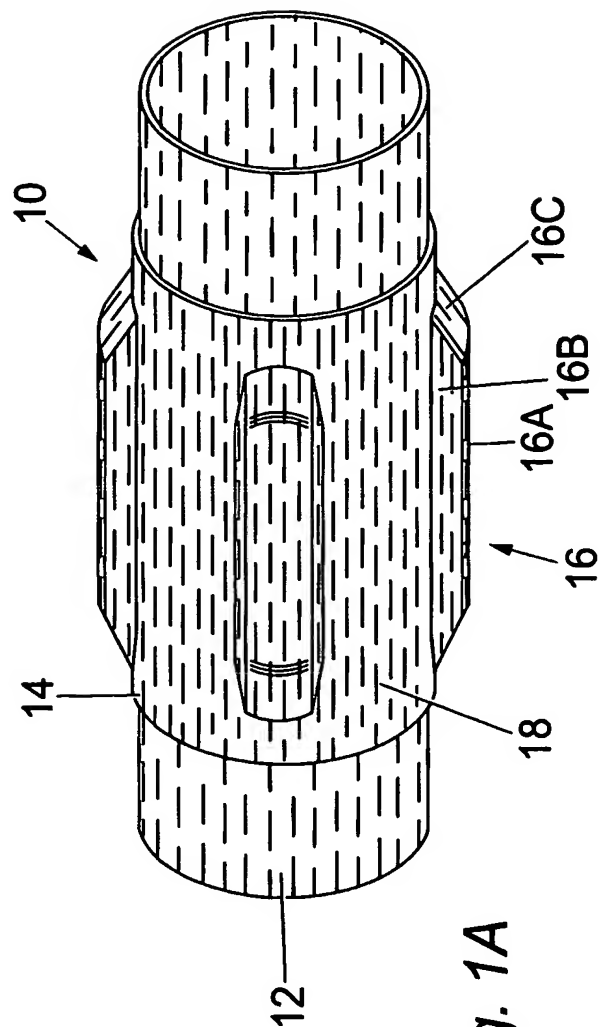
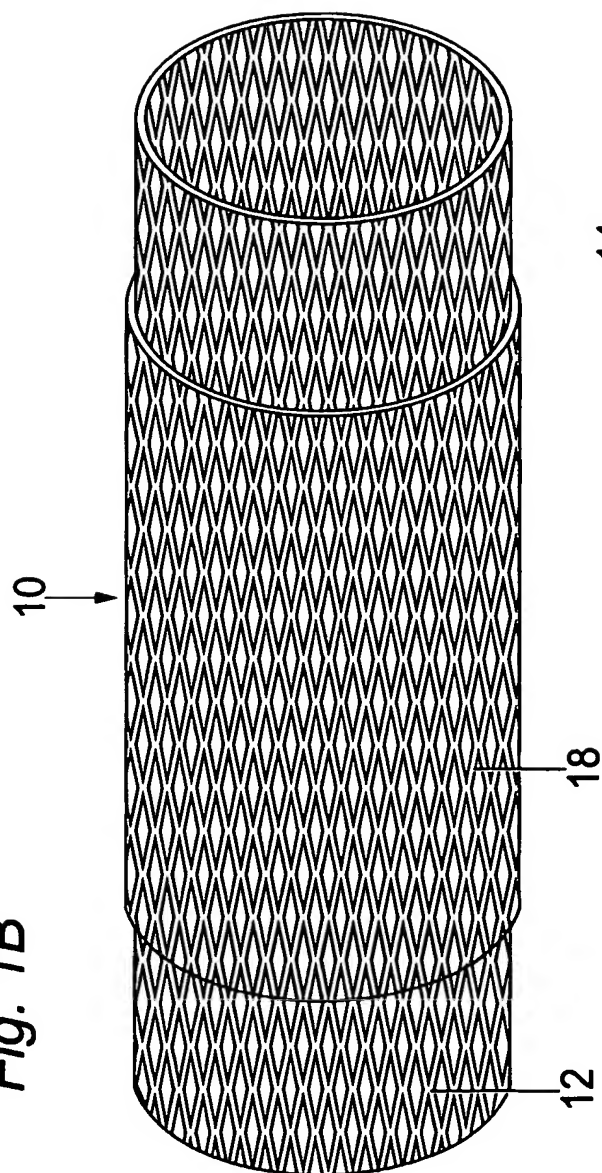
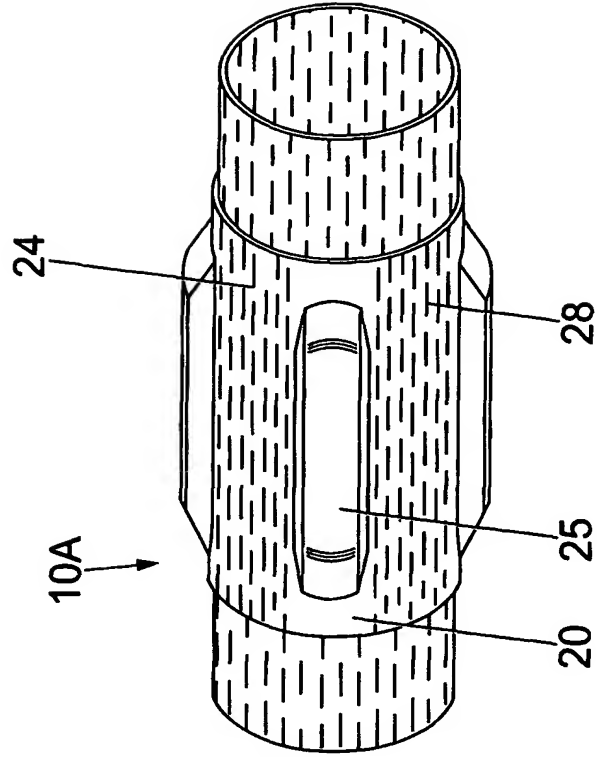
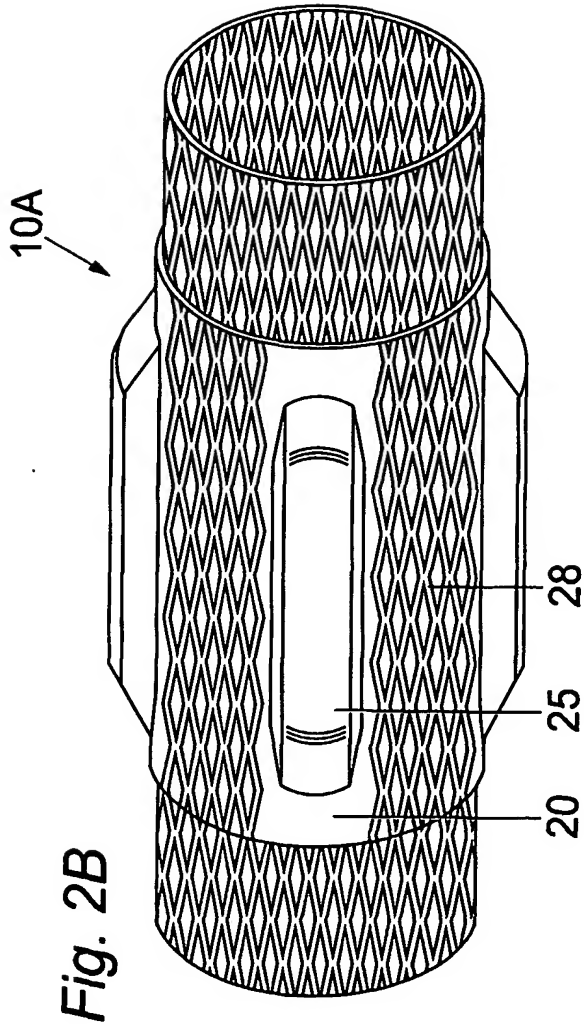


Fig. 1A

2 / 2





# INTERNATIONAL SEARCH REPORT

International Application No

PCT/GB 03/01022

## A. CLASSIFICATION OF SUBJECT MATTER

IPC 7 E21B43/10

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 7 E21B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal

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☒ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

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Date of the actual completion of the international search

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# INTERNATIONAL SEARCH REPORT

International Application No

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## C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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